Sustainable food: can food labels make consumers switch to meat substitutes?

Fredrik Carlsson[*] [b,c], Mitesh Kataria[ξ,b], Elina Lampi[ζ,b,c]

Abstract
Using a stated preference survey, we investigate whether the introduction of a set of food labels affects consumers´ willingness to make costly shifts from meat products to meat substitutes. We investigate the role of food labels relating to health, use of antibiotics, climate impact, and animal care. We find that climate and healthiness labeling of substitutes increases the likelihood that consumers will switch to such products. We also find that labeling of the meat option can play an important role when choosing a food product. Labels concerning animal care, antibiotics use, and healthiness are all important for consumers' choices, while a climate impact label placed on meat plays a smaller role. If meat is produced with severe restrictions on antibiotics use and the producers guarantee a high level of animal care, consumers will generally, all else equal, prefer the meat alternative. Twenty-five percent of the respondents are not willing to choose anything other than meat in the experiment. This subset of consumers are probably very difficult to influence. We find, however, that making a meat substitute taste more like meat is a key factor for those with limited experience of consuming soy products.

Keywords: meat substitutes, stated preferences, labels,

JEL-classification: Q18, Q51

Acknowldgements: We have received financial support from Formas through the project Identifying and Understanding Obstacles for Sustainable Consumption with Meat Substitute as a Case Study.
[*] University of Gothenburg, Department of Economics, Box 640, 405 30 Gothenburg, Sweden; Telephone: + 46 31 7864174; e-mail: fredrik.carlsson@economics.gu.se.
[b] Center for Collective Action Research, University of Gothenburg.
c Centre for Antibiotics Resistance Research, University of Gothenburg.
[ξ] University of Gothenburg, Department of Economics, Box 640, 405 30 Gothenburg, Sweden; Telephone: + 46 31 7861352; e-mail: mitesh.kataria@economics.gu.se.
[ζ] University of Gothenburg, Department of Economics, Box 640, 405 30 Gothenburg, Sweden; Telephone: + 46 31 7861393; e-mail: elina.lampi@economics.gu.se

1. Introduction

Many experts argue that there is a need to reduce meat consumption in developed countries (Stoll-Kleemann and Schmidt, 2017). Meat production gives rise to about 15 percent of total global greenhouse gas emissions (Gerber et al., 2013), and thus, a reduction of such emissions is considered important (Revell, 2015; Godfray et al., 2018; Sanchez-Sabate and Sabaté, 2019; González et al., 2020). However, greenhouse gas emissions is not the only problem linked to meat production. The development of antibiotic resistance due to overuse of antibiotics in livestock production is another serious concern (Witte, 1998; Chang et al., 2015). In addition, consumption of red meat and especially processed meat is carcinogenic to humans (McAfee et al., 2010; González et al., 2020). There are also ethical aspects associated with how animals are treated in animal husbandry and whether the killing of animals can be justified (Bennet, 1997; Velarde et al., 2015). Little is known about how consumers value these different aspects of meat consumption.

A major possible way to influence meat consumption is to change the relative price of meat, for example through a tax (Säll and Gren, 2015; Bonnet et al., 2018; Springmann et al., 2018; Jarka et al., 2018; Carlsson et al., 2021b). However, implementing a tax is not straightforward, and taxes on meat are often met with political opposition (Grimsrud et al., 2020). Voluntary action and changes in consumer behavior due to information campaigns (Laestadius et al., 2013) or informative labels on aspects such as climate impact (Grunert et al., 2014; Van Loo et al., 2014; Shewmake at al., 2015; Leach et al., 2016; Muller et al., 2019; Carlsson et al., 2021a; Edenbrandt and Lagerkvist, 2021; Edenbrandt et al., 2021) are in all likelihood also important elements. In addition, people are under a time constraint when shopping and labels have been shown to decrease search behavior (e.g., Teisl and Roe, 1998). Labels might also help translate consumer attitudes and intentions into actual consumption behavior since they have been found to increase perceived behavioral control among consumers (Aitken et al., 2020). To change the consumption behavior, however, consumers need to have trust in the labels and the institutions behind them (Gorton et al., 2021).

It is of great interest to explore the effect of labels concerning various characteristics of food products and to investigate how consumers value various aspects of meat consumption. In this paper, we investigate the effects of four different product labels on people's choice between meat and a soy-based meat substitute. In particular, we investigate labels relating to antibiotics use, animal care, climate impact, and healthiness, where the two latter are used for both the meat and the meat substitute product. In addition, we investigate the role of prices. We do this by conducting a choice experiment study in Sweden, where meat is an important part of the food culture. Swedes consumed about 40 percent more meat in 2013 than 30 years earlier (Swedish Board of Agriculture, 2013), although the meat consumption has decreased somewhat in the last few years (Swedish Board of Agriculture, 2019).

Shifting consumer demand from meat to other options has proven to be challenging, but possible. Stoll-Kleemann and Schmidt (2017) found that the most relevant factors that influence behavior regarding meat consumption are emotions, cognitive dissonance, and sociocultural factors such as social norms and social identity. Zur and Klöckner (2014) found that habits are the most important explanations for meat consumption, but that it is possible for individuals to change their consumption patterns if they are willing to do so. They found that moral aspects, health aspects, and attitudes are three main drivers of dietary changes. Cheah et al. (2020) found that health benefits is a primary reason to decrease meat consumption. In contrast, active avoidance of information has been found to be a barrier to changes in consumption behavior (Edenbrandt et al., 2021). Moreover, it is likely that different groups of consumers are more or less affected by policies and that the factors driving their behavior vary. Stoll-Kleemann and Schmidt (2017) found that provision of negative health arguments about meat may be the most promising approach in efforts to change the meat consumption behavior among men and older people, while emotional messages and promotion of new social norms are recommended in order to reduce barriers based on cognitive dissonance.

In this study, we find that labels can play an important role for the choice of food products. Climate labels and healthiness labels placed on the meat substitute

increases the likelihood that consumers will choose such a product. Hence, if the meat substitute can be made distinguishable from the meat product in these respects, there is potential to influence consumers' behavior. We also find that labeling of the meat product can play an important role. Labels relating to animal care, antibiotics use, and healthiness are all important for the choice between meat and soy-based lasagna. However, climate impact labeling of meat plays a smaller role compared with the other studied labels. If the meat alternative is produced with full restriction of antibiotics use (i.e., antibiotics are only allowed for the treatment of sick animals and as prescribed by a veterinarian) and very good animal care is guaranteed, the consumers will generally, all else equal, prefer the meat alternative. Finally, twenty-five percent of the respondents are not willing to choose anything other than meat in the experiment. This subset of consumers are probably very difficult to influence when it comes to food choices.

The rest of the paper is organized as follows. In Section 2, we present the design of the survey experiment and the survey sampling. Section 3 presents the results and in Section 4 we discuss the implications of the study.

2. Survey design

2.1 Design of the experiment

The survey started with a screening question since the desired sample consisted of respondents who regularly buy ready-made meals with meat, such as lasagna, meatballs, and pizza. Those who did not regularly consume any meat products were dropped from the survey immediately after the screening question. In the second section, we provided information about the labels. The respondents then made six choices where they were asked which alternative (meat or meat substitute) they would choose in a real shopping situation. In the same section, we also asked questions about whether any of the following would make them switch to a meat substitute: a lower price, a meat tax, higher visibility of substitute products in stores, meat substitutes tasting more like meat, and meat substitutes carrying labels

informing them about the levels of antibiotics use, climate impact, animal care, etc. The last section of our survey consisted of questions about the respondents' socio-economic status. .

The food product used in the experiment was frozen lasagna. Subjects were to choose between two options, one with meat and one soy-based vegetarian. The first three labels were of a public good nature, as they concerned antibiotics use, animal care, and climate impact. We explained that since antibiotics can spread from animal production to the environment, the use of antibiotics in meat production increases the risk of antibiotic resistance, and thus, decreasing the use of antibiotics for animals will decrease this risk. The antibiotics use label had three levels, where the highest level was full restriction, meaning that antibiotics are only allowed for the treatment of sick animals and as prescribed by a veterinarian. The animal care label had three possible levels, too, ranging from lacking to very good depending on the stable environment and grazing opportunities. The third label, climate impact, described the climate impact of meat and soy production. This label also had three levels, ranging from large to small impact. For the soy product, the impact could only be medium or small. Finally, the last label concerned healthiness, a factor of private nature. Healthiness, too, had three levels, ranging from unhealthy to healthy. Unhealthy food was defined as food with higher levels of fat, sugar, and salt and lower levels of whole grain and fibers. The exact information regarding the labels and their levels can be found in Table A1 in the Appendix. The levels of the labels were illustrated with a traffic light system using the colors red, yellow, and green (see, e.g., Balcombe et al., 2010; Emrich et al., 2017; Carlsson et al., 2021a). It was explicitly stated in the instructions that red represented a bad choice, yellow an intermediate, and green a good choice.

Next, we presented an example of a choice set. The respondents were informed that they should answer according to how they would actually behave in a real-life shopping situation (in store or online) and that they could only choose one of two options. We explained that the geographic origin of the meat was not known for

any of the lasagnas[1] and that all of them were equally tasty and contained equal amounts of meat/soy. We asked the respondents to carefully compare the different alternatives before making their choices. In addition, we added the following text to emphasize that it was important to respond in line with the choices they would actually make in a real shopping situation:

> "There is no right or wrong answer, and we researchers have no opinion about what is good or bad. It is important that you answer in line with what you think you would choose in a real situation, for example in a store, even if you do not actually buy anything. Therefore, we ask you to answer with your hand on your heart."

To reduce experimental demand effects, we emphasized that we *as researchers* had no opinion on what constitutes a good choice (Carlsson et al., 2018). To "answer with hand on heart" is a common idiom in Swedish and all respondents should understand the meaning of it: to answer truthfully ("to put a hand on your heart" and "to cross your heart" are close equivalents in English). Since a person might buy different varieties of products on different occasions, we also informed them that they should choose the product they would buy most often. We then showed them an example of a choice set; see Figure 1.

	Meat lasagna	Soy lasagna
Use of antibiotics	No restriction 🔴○○	Plant based, so no antibiotics or animal husbandry
Animal care	Poor 🔴○○	
Climate impact	Large: > 4 kg 🔴○○	Medium: 3–4 kg ○🟡○
Healthiness	Healthy ○○🟢	Unhealthy 🔴○○
Price	30 kr	55 kr

Hand on my heart, in a real shopping situation I would choose		

Figure 1. An example of a choice set

[1] This was important since antibiotics use and animal care are strictly regulated in Swedish beef production, and thus, most people know that Swedish meat products meet the highest available requirements in terms of these two labels.

Right before they started making their choices, we reminded the respondents about their budget restriction and that a normal price of a frozen meat lasagna is 30 SEK[2].

In total, respondents answered six choice sets. The first five sets were randomly drawn from a D-efficient alternative-specific design with zero priors generating 24 choice sets. The sixth choice set was always the same, and it is used to identify subjects who would, given the setting of our experiment, never switch to the meat substitute alternative. To identify these respondents, we presented an option where the meat lasagna had the worst possible levels (only red traffic lights) on all labels and the highest possible price, and where the soy lasagna had best possible levels (only green traffic lights) on all labels and the lowest possible price. If a respondent still chose the meat alternative under these conditions, then the levels of the labels and prices obviously did not affect that person´s choices.

After the choice experiment, the respondents were asked a set of follow-up questions. For example, we asked them questions about their typical behavior when buying groceries. We also asked them whether they were usually able to find the options they preferred in terms of antibiotics use, animal care, climate impact, and healthiness when shopping. Finally, we asked them about what effect different government policies could have on their decision to purchase meat substitutes.

The last section of the survey contained questions about the respondents' socio-economic status and whether they regularly bought products that were organic, locally produced, or labeled as a healthy choice and whether they regularly chose Swedish products when buying meat.

2.2 Survey sampling

The study was conducted as a web survey in May 2021. Before the main study, a pilot study was conducted with satisfactory results. The respondents were recruited randomly from a representative panel of the Swedish population. However, to be eligible to participate, the respondent had to purchase ready-made meals more than just a few times per month. The survey therefore started with a screening question,

[2] 1 SEK ≈ 0.10 USD at the time of the survey.

and if the respondent reported to only buy ready-made meals 0–2 times per month, they were not invited to participate in the survey. Moreover, in order to screen out subjects who did not pay enough attention to the information, we set a minimum response time of 4 minutes. The final survey yielded 1,471 responses. The median response time was between 7 and 8 minutes, and the mean was almost 12 minutes. Descriptive statistics are presented in Table 1, together with responses to a set of attitudinal questions.

Table 1. Descriptive statistics.

Variable	Description	Mean
Female	=1 if female	0.45
Age 18–29 years	= 1 if between 18 and 29 years old	0.24
Age: 30–49 years	= 1 if between 30 and 49 years old	0.39
Age: 50–67 years	= 1 if between 50 and 67 years old	0.20
Age: 68 years–	= 1 if 68 or more years old	0.16
University	=1 if a university education ≥3 years	0.48
Kids < 10	= 1 if at least one child in household is age 18 or under	0.38
Income	Income before taxes in thousands SEK per month per adult hh member	2.67
No response income	= 1 if not willing to respond to question on income	0.11
Big city	= 1 if household is in Stockholm, Gothenburg, or Malmö	0.31
Number of respondents		1,471

The share of respondents in our sample with at least three years of university education is 48 percent, which is higher than the 28 percent share at the national level (Statistics Sweden, 2020). The share of females is 45 percent in our sample, which is fairly close to the national share of 50 percent. Note that for the specific purpose of our study, the relevant population is not Swedish citizens in general.[3]

[3] A requirement for participation in the survey was regular consumption of meat, and it is therefore difficult to directly compare sample characteristics with population characteristics. However, being a vegetarian tends to be more common among women and highly educated persons (see, e.g., Pfeiler and Egloff, 2018).

3. Results

3.1 Descriptive results

As described above, there were 1,471 subjects, and they all made six choices, where the last one was always the same and made it possible to identify those who are unwilling to ever switch to a meat substitute given the setting of the experiment. About 25 percent of the respondents chose the meat alternative in this last choice set. Among the subjects who were willing to switch, the soy lasagna was chosen around 47 percent of the times. The experiment thus seems to be well balanced and a majority of the subjects made trade-offs between the two options.

3.2 Who is willing to switch to meat substitutes and who is a persistent meat eater?

To begin with, we investigate whether the willingness to switch to a meat substitute is associated with any observable subject characteristics. We estimate a binary logit model where the dependent variable is equal to 1 if they opted for the soy lasagna in the final choice set. Results are presented in Table 2, where we report marginal effects at sample mean. For a dummy variable, the marginal effect shows the change in probability when the dummy variable changes from 0 to 1. For a continuous variable, the marginal effect shows the marginal change in probability for a marginal change in the independent variable.

Table 2. Respondents willing to switch to meat substitute; marginal effects at sample mean from binary logit model.

Variable	Willing to switch
Female	0.037
	(0.023)
Age: 30–49 years	0.011*
	(0.032)
Age: 50–64 years	-0.069**
	(0.033)
Age: 65– years	-0.055
	(0.037)
University education	0.081***
	(0.024)
Big city	-0.011
	(0.025)
Children in household	-0.045*
	(0.026)
Income per adult	0.004
	(0.008)
No response income	-0.062
	(0.041)
Observations	1,471

Notes: Dependent variable equals 1 if subject chose soy lasagna in the final choice set. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10

University educated are eight percentage points more likely than others to switch to a meat substitute, i.e., the effect is sizeable. This also means that people without a university education are more likely to be identified as persistent meat eaters. Middle-aged respondents and respondents with kids in the household are also more likely to be identified as persistent meat eaters. These three are the only observable subject characteristics that identify the persistent meat eaters.

3.3 The role of food labels

Next, we investigate the role of the different food labels on the decision to switch to a meat substitute. We estimate a random effects logit model, where the dependent variable is 1 if the soy lasagna was chosen in a particular choice set. Estimations are based on the first five choice sets. In the main text, we report results from the restricted sample of subjects who were willing to at least once choose the soy lasagna. In the appendix, we report results for the full sample. The results are very similar. The first model that we present in the first column only includes the

attributes of the choice experiment (the labels and the price). In the second column, we present the results of a model that includes a set of socio-economic characteristics as explanatory variables as well. Note that we use the middle level of the labels as reference case; thus, since we estimate the likelihood of choosing the vegetarian option, the lower/inferior levels of all vegetarian labels are predicted to have negative and the upper/preferred levels are predicted to have positive signs, and the lower levels of all meat labels are predicted to have a positive sign. Results are presented in Table 3.

Table 3. Willingness to choose the soy lasagna, coefficients from random effects logit model, only including those who are willing to switch to the soy lasagna.

		(1)	(2)
Meat:	Antibiotics use: no restriction	0.580***	0.581***
		(0.175)	(0.175)
	Antibiotics use: full restriction	-1.035***	-1.037***
		(0.152)	(0.152)
	Animal care: poor	1.043***	1.043***
		(0.150)	(0.150)
	Animal care: very good	-0.753***	-0.762***
		(0.181)	(0.180)
	Climate impact: large	0.167	0.170
		(0.183)	(0.183)
	Climate impact: small	-0.334*	-0.332*
		(0.181)	(0.180)
	Health: unhealthy	0.729***	0.728***
		(0.135)	(0.135)
	Health: healthy	-0.460***	-0.454***
		(0.157)	(0.156)
Soy:	Climate impact: small	0.471***	0.459***
		(0.149)	(0.149)
	Health: unhealthy	-0.767***	-0.771***
		(0.211)	(0.210)
	Health: healthy	0.425***	0.424***
		(0.155)	(0.155)
		(0.157)	(0.156)
Cost		-0.065***	-0.065***
		(0.005)	(0.005)
Female			0.705***
			(0.147)
Age: 30–49 years			-0.100
			(0.200)
Age: 50–64 years			-0.045
			(0.220)
Age: 65– years			0.057
			(0.238)
University education			0.359**
			(0.151)
Big city			0.144
			(0.158)
Children in hh			-0.123
			(0.170)
Income per adult			-0.046
			(0.052)
No response income			0.165
			(0.284)
Constant		-0.568**	-0.914***
		(0.228)	(0.308)
Observations		5,535	5,535
Number of subjects		1,107	1,107

Notes: Dependent variable is 1 if vegetarian option is chosen in the choice experiment
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

We begin with model 1, which only includes the attributes of the choice experiment. The effects on the willingness to choose the meat substitute are in line with our expectations. The alternative specific constant, is negative, indicating that the respondents were generally more likely to choose meat than soy lasagna. Apart from the climate label for the meat option, all effects are statistically significant at the 1 percent level. Including a set of individual characteristics does not affect the coefficient estimates of the attributes to any extent. Furthermore, the results suggest that women and university educated were more likely to choose the meat substitute.

Table 4 reports mean marginal willingness to pay (MWTP) for the labels, based on model 1; again remember that the reference case is the medium level of each label.[4] Moreover, these estimates are only for the subjects who were willing to switch to the meat substitute.

Table 4. Estimated marginal willingness to pay for different levels of the food labels

	Soy lasagna	Meat lasagna
Antibiotics use: no restriction		-9.0***
		(2.9)
Antibiotics use: full restriction		16.0***
		(2.4)
Animal care: poor		-16.1***
		(2.3)
Animal care: very good		11.6***
		(3.1)
Climate impact: large		-2.6
		(2.9)
Climate impact: small	7.3***	5.1*
	(2.4)	(2.7)
Healthiness: unhealthy	-11.8***	-11.2***
	(3.8)	(3.8)
Healthiness: healthy	6.6***	6.6***
	(2.3)	(2.3)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The MWTP estimates reveal many interesting things. First, the part-worth of the labels put on both the meat and the soy lasagna does not to any large extent depend on whether it is the meat or meat substitute product that is labelled. The MWTPs

[4] MWTP is the ratio between the attribute coefficient and the price coefficient.

for the climate impact and the health labels are about the same between the two options. Second, overall, the climate impact label has the lowest MWTP, while the labels for animal care and antibiotics use have the highest. The MWTP for full restrictions on antibiotics use is 16 SEK, and for very good standard in animal care it is about 12 SEK. When it comes to the healthiness labels, for both meat and soy lasagna, the MWTP to avoid the unhealthiest lasagna (11.2–11.8 SEK) is clearly larger than the MWTP for the healthiest lasagna (6.6 SEK). Finally, the alternative-specific constant is negative, indicating that consumers are, all else equal, willing to pay 8.7 SEK more for a meat lasagna than for the meat substitute.[5] Since the sums of the part-worth of the labels are considerably large, we can conclude that if the meat substitute is labeled with levels that are preferred by consumers, compared with the meat alternative, people will switch to the meat substitute. At the same time, if the meat alternative has labels with green lights, consumers will prefer the meat product.

3.4 Current behavior

We asked the subjects whether they felt they were able to find products that met their requirements for level of antibiotics use, animal care, climate impact, and healthiness when buying groceries. Around 52 percent said they were never or very rarely able to do that, indicating that the current labels used in the marketplace are not informative enough. We then asked them how important the five different attributes were when making decisions about food in stores. Figure 2 shows the distribution of responses.

[5] This is calculated by taking the ratio of the intercept and the cost coefficient.

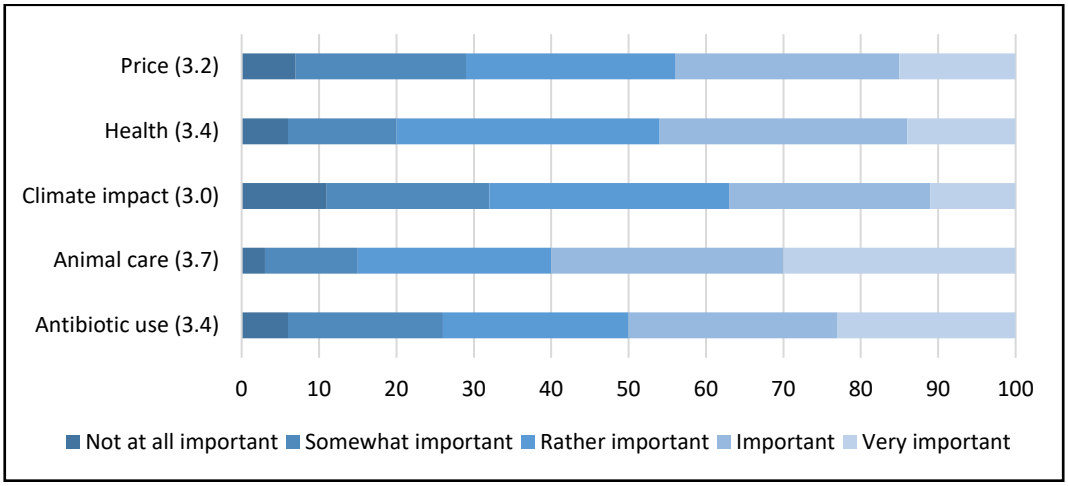


Figure 2. Distribution of stated importance when making food decisions at the store today. Average values in parentheses.

These responses are in line with the results of the choice experiment. Climate impact is again the least important characteristic and antibiotics use the most important. These results also confirm previous findings about Swedish consumers' preferences (Carlsson et al., 2021a).

Moreover, previous experience with soy products varies greatly among the respondents: 40 percent purchase soy products regularly, but 10 percent have never tried them and almost 50 percent have purchased them only a few times.

3.4 What can make consumers choose meat substitutes more often, according to consumers?

Finally, the use of labels is only one possible factor that affects consumers' choices between meat and meat substitutes. Therefore, we also asked the respondents about other factors that may increase their purchasing of meat substitutes. We included six different suggestions and the respondents were asked to respond to them using a scale from 1 to 10, where 1 meant that the suggestion would "not at all" make them eat more meat substitutes and 10 meant "to a very large extent." The distribution of responses is presented in Figure 3.

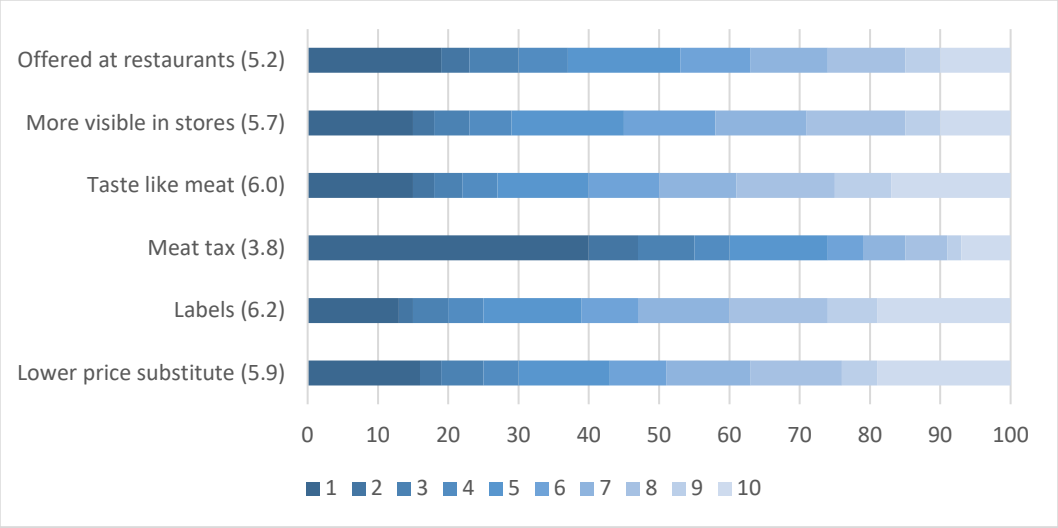


Figure 3. Stated perceived effect of various determinants on affecting decision to switch to meat substitutes, 1 = not at all, … , 10 = to a very large extent. Average values in parentheses.

Respondents believe that food labels are most likely to affect their behavior, followed by taste – in particular that the meat substitute should taste more like meat - and a lower price of meat substitutes. Also making meat substitutes more visible in stores could facilitate a switch to a meat substitute. This result is in line with the findings by Weinrich (2019), who argued that easy availability is essential for long-term success. Respondents are by far the most negative toward a meat tax. Clearly, a higher price of meat (through for example a tax) is the flip side of a lower price of a meat substitute. Still respondents are much more negative to a meat tax than a lower price of the substitute. There is often a general reluctance to taxes, even a carbon tax on meat or gasoline (Umit and Schaffer, 2020). The direct cost to consumers is of course the most salient for this type of policy. It is also possible that people believe it is more effective or fair to reward good than to punish bad behavior.

As we have seen, there is substantial heterogeneity in responses to the food labels, and also in terms of how often subjects have purchased soy products in the past. We therefore also explore how attitudes to switching to meat substitutes vary with previous experience with soy products. In Table B2 in the appendix we report the mean values for the policies for four groups of respondents, ranging from those

that often buy soya to those who have never buy soya products. Naturally, those with limited experience with soy products say it is less likely that they will be influenced by any of the factors; they also rank improvement in taste as the most effective factor. In contrast, those who eat soy products very often ranked taste as the least important factor. This is consistent with previous findings around taste, where there is often large heterogeneity in preferences (see, e.g., Collier et al., 2021). What our results suggest is that making meat substitutes taste more like meat is important if the goal is to capture consumers who are unfamiliar with soy products. Introduction of a meat tax is clearly a disliked policy among all respondents except those who already often eat soy products. Labels are in general ranked high in all groups.

4. Conclusions and discussion

By carefully drafting a survey and conducting a choice experiment study among Swedish consumers, we investigate the role of four different product labels on the choice between meat and meat substitutes (soy based). In particular, we investigate labels providing information about antibiotics use, animal care, climate impact, and healthiness, where the two latter are labels used for both meat and meat substitutes. We find that only 25 percent of the subjects chose the meat alternative persistently, while the remaining 75 percent expressed a willingness to switch to the meat substitute under certain conditions. Seventy-five percent is a considerable fraction, but there is also of course a non-negligible share of subjects who are very reluctant to switch. Moreover, if the meat alternative is produced with full restrictions on antibiotics use and a high level of animal care, the consumers will generally, all else equal, prefer the meat alternative. We also find that people without university education, middle-aged respondents, and those with children in the household are more likely than others to be persistent meat eaters.

There is strong evidence from the survey responses that food labels can play an important role for people's food choices. This is revealed both by the behavior in the choice experiment and by the follow-up questions about factors that would make the subjects switch to meat substitutes. Labels indicating that a meat substitute

offers a lower climate impact and is more healthy compared with the meat alternative can increase the likelihood that subjects choose the meat substitute. Notably, the climate impact label played a much smaller role than the other studied labels in the respondents' decision making. This is consistent with previous findings on Swedish consumers (Carlsson et al., 2021a). Another finding that emphasizes the need for labels on products is that around 52 percent of our sample said that they could never or very rarely find options that they preferred in terms of antibiotics use, animal care, climate impact, and healthiness when shopping.

We also find that taste was ranked as most important by those who never or very rarely eat soy products. In summary, we find that a majority of the respondents are currently unable to find the information they would like. In addition, consumers seem to demand better information through labels, and their stated intentions reveal that this could affect their purchasing behavior.

References

Aitken, R., Watkins, L., Williams, J., & Kean, A. (2020). The positive role of labelling on consumers' perceived behavioural control and intention to purchase organic food. *Journal of Cleaner Production*, *255*, 120334.

Balcombe, K., Fraser, I., & Di Falco, S. (2010). Traffic lights and food choice: A choice experiment examining the relationship between nutritional food labels and price. *Food Policy*, *35*(3), 211-220.

Bonnet, C., Bouamra-Mechemache, Z., & Corre, T. (2018). An environmental tax towards more sustainable food: empirical evidence of the consumption of animal products in France. *Ecological Economics*, 147, 48-61

Carlsson, F., Kataria, M., & Lampi, E. (2018). Demand effects in stated preference surveys. *Journal of Environmental Economics and Management*, 90, 294-302.

Carlsson, F., Kataria, M., Lampi, E., Nyberg, E., Sterner, T. 2021a. Food labels: how consumers value moral, environmental, and health aspects of meat consumption, *European Review of Agricultural Economics*, forthcoming.

Carlsson, F., Kataria, M., & Lampi, E. (2021b). How much does it take? Willingness to switch to meat substitutes. Working paper, University of Gothenburg.

Chang, Q., Wang, W., Regev-Yochay, G., Lipsitch, M., & Hanage, W. P. (2015). Antibiotics in agriculture and the risk to human health: how worried should we be? *Evolutionary Applications*, *8*(3), 240-247.

Collier, E., Oberrauter, L-M., Normann, A., Normann, C., Svensson, M., Nimi, J, Bergman, P. (2021). Identifying barriers to decreasing meat consumption and increasing acceptance of meat substitutes among Swedish consumers, *Appetite*, forthcoming.

Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., ... & Tempio, G. (2013). *Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities*. Food and Agriculture Organization of the United Nations (FAO).

Cheah, I., Shimul, A. S., Liang, J., & Phau, I. (2020). Drivers and barriers toward reducing meat consumption. *Appetite*, *149*, 104636.

Emrich, T. E., Qi, Y., Lou, W. Y., & L'Abbe, M. R. (2017). Traffic-light labels could reduce population intakes of calories, total fat, saturated fat, and sodium. *PloS One*, *12*(2), e0171188.

Godfray, H. C. J., Aveyard, P., Garnett, T., Hall, J. W., Key, T. J., Lorimer, J., ... & Jebb, S. A. (2018). Meat consumption, health, and the environment. *Science*, *361*(6399).

González, N., Marquès, M., Nadal, M., & Domingo, J. L. (2020). Meat consumption: which are the current global risks? A review of recent (2010-2020) evidences. *Food Research International*, 109341.

Gorton, M., Tocco, B., Yeh, C. H., & Hartmann, M. (2021). What determines consumers' use of eco-labels? Taking a close look at label trust. *Ecological Economics*, *189*, 107173.

Grimsrud, K. M., Lindhjem, H., Sem, I. V., & Rosendahl, K. E. (2020). Public acceptance and willingness to pay cost-effective taxes on red meat and city

traffic in Norway. *Journal of Environmental Economics and Policy*, *9*(3), 251-268.

Edenbrandt, A. K., & Lagerkvist, C. J. (2021). Is food labelling effective in reducing climate impact by encouraging the substitution of protein sources? *Food Policy*, *101*, 102097.

Edenbrandt, A. K., C. J. Lagerkvist, and J. Nordström (2021). Interested, indifferent or active information avoiders of carbon labels: Cognitive dissonance and ascription of responsibility as motivating factors. *Food Policy*: 102036.

Grunert, K. G., Hieke, S., & Wills, J. (2014). Sustainability labels on food products: Consumer motivation, understanding and use. *Food Policy*, *44*, 177-189.

Jarka, C., Tinggaard, S. G., & Tomas, Z. (2018). A global meat tax: from big data to a double dividend. *Agricultural Economics*, *64*(6), 256-264.

Laestadius, L. I., Neff, R. A., Barry, C. L., & Frattaroli, S. (2013). Meat consumption and climate change: the role of non-governmental organizations. *Climatic Change*, *120*(1-2), 25-38.

Leach, A. M., Emery, K. A., Gephart, J., Davis, K. F., Erisman, J. W., Leip, A., ... & Castner, E. (2016). Environmental impact food labels combining carbon, nitrogen, and water footprints. *Food Policy*, *61*, 213-223.

Muller, L., Lacroix, A., & Ruffieux, B. (2019). Environmental labelling and consumption changes: A food choice experiment. *Environmental and Resource Economics*, *73*(3), 871-897.

McAfee, A. J., McSorley, E. M., Cuskelly, G. J., Moss, B. W., Wallace, J. M., Bonham, M. P., & Fearon, A. M. (2010). Red meat consumption: An overview of the risks and benefits. *Meat Science*, *84*(1), 1-13.

Pfeiler, T. M., & Egloff, B. (2018). Examining the "Veggie" personality: Results from a representative German sample. *Appetite*, 120, 246-255.

Revell, B. J. (2015). One Man's Meat… 2050? Ruminations on future meat demand in the context of global warming. *Journal of Agricultural Economics*, *66*(3), 573-614.

Sanchez-Sabate, R., & Sabaté, J. (2019). Consumer attitudes towards environmental concerns of meat consumption: A systematic review. *International Journal of Environmental Research and Public Health*, *16*(7), 1220.

Shewmake, S., Okrent, A., Thabrew, L., & Vandenbergh, M. (2015). Predicting consumer demand responses to carbon labels. *Ecological Economics*, *119*, 168-180.

Springmann M., Mason-D'Croz D., Robinson S., Wiebe K., Godfray H., Rayner M. (2018). Health-motivated taxes on red and processed meat: A modelling study on optimal tax levels and associated health impacts. *PLoS One*, 13(11).

Stoll-Kleemann, S., & Schmidt, U. J. (2017). Reducing meat consumption in developed and transition countries to counter climate change and biodiversity loss: a review of influence factors. *Regional Environmental Change*, *17*(5), 1261-1277.

Säll, S., & Gren, M. (2015). Effects of an environmental tax on meat and dairy consumption in Sweden. *Food Policy*, *55*, 41-53.

Teisl, M. F., & Roe, B. (1998). The economics of labeling: An overview of issues for health and environmental disclosure. *Agricultural and Resource Economics Review*, 27(2), 140-150.

Umit, R., & Schaffer, L. M. (2020). Attitudes towards carbon taxes across Europe: The role of perceived uncertainty and self-interest. *Energy Policy*, 140, 111385.

Van Loo, E. J., Caputo, V., & Lusk, J. L. (2020). Consumer preferences for farm-raised meat, lab-grown meat, and plant-based meat alternatives: Does information or brand matter? *Food Policy*, *95*, 101931.

Weinrich, R. (2019). Opportunities for the adoption of health-based sustainable dietary patterns: A review on consumer research of meat substitutes. *Sustainability*, *11*(15), 4028.

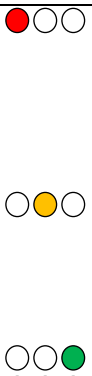
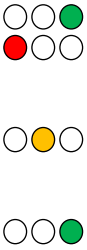
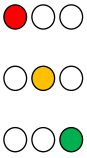
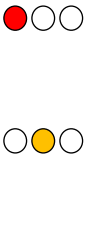
Velarde, A., Fàbrega, E., Blanco-Penedo, I., & Dalmau, A. (2015). Animal welfare towards sustainability in pork meat production. *Meat science*, *109*, 13-17.

Witte, W. (1998). Medical consequences of antibiotic use in agriculture, *Science*, 279, 997-997

Zur, I., & Klöckner, C.A. (2014). Individual motivations for limiting meat consumption. *British Food Journal*, 116, 629-642.

APPENDIX A. Attribute description in experimental instructions

Table A1. Attributes, the description of the attributes, and the attribute levels.

Attribute	Description	Attribute levels	
Antibiotics use	Antibiotics use in meat production entails a risk for antibiotics resistant bacteria to spread. This could complicate the treatment of bacterial infections such as tonsillitis and surgery-related infections in humans. Since antibiotics-treated animals have to wait a while before being slaughtered, there is no risk of acquiring resistant bacteria from ingestion of the meat. Reduced usage of antibiotics reduces the risk for antibiotics-resistant bacteria.	No restriction: Antibiotics may be used to prevent diseases as prescribed by veterinarians, and for growth-promotion in healthy animals. Some restrictions: Antibiotics may *not* be used for growth-promotion purposes, but to prevent diseases as prescribed by veterinarians. Full restriction: Antibiotics may *not* be used for growth-promotion, but for ill animals as prescribed by veterinarians.	
Animal care	Well-being among animals depends on, e.g., the stable environment and if they have opportunities for grazing. The stable environment denotes aspects such as spaciousness, access to a dry sleeping area, hygiene, noise level, and access to food and water.	Poor: A poor stable environment and no opportunities for grazing Medium: A good stable environment and opportunities for grazing Very good: A very good stable environment and opportunities for grazing	
Climate impact	Animal keeping generates one fifth of total global emissions of greenhouse gases. Emission levels depend on animal species, where beef has the largest impact. The emissions from cows depend on, e.g., the animals' lifespan and the amount and type of fodder. The label describes the amount of the meat's emissions in kg greenhouse gases emitted per portion (1 kg is equivalent to driving a car approximately 5 kilometers). The vegetarian lasagna is made with soy. Soybean cultivation increased deforestation in the Amazons, which has an impact on climate change. The extent of the climate impact depends on where they soy is cultivated. The labels described the amount of the soy's emissions in kg greenhouse gases emitted per portion (1 kg is equivalent to driving a car approximately 5 kilometers).	Large: More than 4 kg Medium: 3–4 kg Small: Less than 3 kg	
Healthiness	Reports how healthy the product is. The label is based on the Swedish Food Agency's recommendations and depends on the amount of sugar, salt and fat (low amounts are good) as well as whole grains and fibers (high amounts are good).	Unhealthy: The product meets none of the recommended levels. Quite healthy: The product meets two of the five recommended levels. Healthy: The product meets all of the recommended levels.	
Price	The price of the lasagna. The average price today is 25 SEK	30, 35, 40, 45, 50, 55 SEK	

Appendix B. Additional tables

Table B1. Willingness to choose the vegetarian lasagna, coefficients from random effects logit model, including all subjects

		(1)	(2)
Meat:	Antibiotics use: no restriction	0.462***	0.469***
		(0.157)	(0.157)
	Antibiotics use: full restriction	-1.049***	-1.044***
		(0.144)	(0.144)
	Animal care: poor	0.916***	0.921***
		(0.139)	(0.139)
	Animal care: very good	-0.667***	-0.668***
		(0.175)	(0.175)
	Climate impact: large	0.128	0.128
		(0.167)	(0.167)
	Climate impact: small	-0.261	-0.262
		(0.173)	(0.173)
	Health: unhealthy	0.714***	0.707***
		(0.121)	(0.121)
	Health: healthy	-0.454***	-0.451***
		(0.149)	(0.149)
Soy:	Climate impact: small	0.519***	0.512***
		(0.141)	(0.141)
	Health: unhealthy	-0.754***	-0.747***
		(0.210)	(0.209)
	Health: healthy	0.562***	0.565***
		(0.142)	(0.142)
Cost		-0.065***	-0.065***
		(0.005)	(0.005)
Female			0.674***
			(0.169)
Age: 30–49 years			-0.111
			(0.230)
Age: 50–64 years			-0.570**
			(0.251)
Age: 65– years			-0.319
			(0.275)
University education			0.643***
			(0.174)
Big city			0.115
			(0.182)
Children in hh			-0.242
			(0.195)
Income per adult			-0.052
			(0.061)
No response income			-0.330
			(0.318)
Constant		-1.687***	-1.857***
		(0.227)	(0.331)
Observations		7,355	7,355
Number of subjects		1,471	1,471

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B2. Mean value and rank concerning stated perceived effect of various determinants on affecting decision to switch to meat substitutes, 1 = not at all, … , 10 = to a very large extent. Four different groups of consumers, based on previous experience of soya products.

Policy	Often buy soy		Regularly buy soy		Bought soy only a few times		Have never bought soy	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Lower price	7.3	3	6.6	2	5.6	3	4.5	3
Labels	7.5	1	7.4	1	5.8	2	4.7	2
Tax	5.9	5	4.1	6	3.4	6	2.6	6
Taste	5.6	6	6.3	4	6.2	1	5.4	1
Visibility	6.9	4	6.5	3	5.2	4	4.3	4
Restaurant	7.4	2	6.1	5	4.6	5	3.7	5